

RESEARCH

Open Access



# Treatment and prognosis of pelvic-related urethral injuries in children: a 20-year single-center study and systematic review

Kongkong Cui<sup>1,2</sup>, Peng Hong<sup>1,2</sup>, Honggang Fang<sup>1,2</sup>, Jie Lin<sup>1,2</sup>, Zaihong Hu<sup>1,2</sup>, Xiaomao Tian<sup>1,2</sup>, Deying Zhang<sup>1,2</sup>, Shengde Wu<sup>1,2</sup>, Xing Liu<sup>1,2</sup>, Qinlin Shi<sup>1,2\*</sup> and Guanghui Wei<sup>1,2</sup>

## Abstract

**Background** Management of pelvic fracture-related urethral injury (PFUI) in children remains debated due to various complications. Patients typically receive either primary realignment (PR) or suprapubic cystostomy with delayed urethroplasty (SCDU), but optimal outcomes are unclear. This study evaluates these two surgical techniques by reviewing 20 years of case data and existing literature.

**Methods** We retrospectively analyzed patients treated for PFUI from 2004 to 2023, with a median follow-up of 2 years (1–15 years). Additionally, we performed a meta-analysis of relevant literature, searching PubMed, Web of Science, and Cochrane databases. Eight studies, including ours, were included in the analysis.

**Results** Sixty-eight boys with PFUI (median age: 7.3 years; range: 4.8–10.8) underwent PR (39) or SCDU (29). Postoperative complications—urethral strictures, urinary incontinence, calculus, infections, and erectile dysfunction—occurred in PR vs. SCDU groups as follows: 38.5% vs. 51.7% ( $p=0.276$ ); 12.8% vs. 3.45% ( $p=0.360$ ); 7.7% vs. 13.8% ( $p=0.678$ ); 56.4% vs. 93.1% ( $p<0.001$ ); and 15.4% vs. 3.5% ( $p=0.231$ ), respectively. PR was associated with lower costs and higher quality of life. The meta-analysis of eight studies involving 432 patients showed no significant differences between PR and SCDU in urethral stricture rates (OR=0.60, 95% CI 0.33–1.10,  $p=0.10$ ), urinary incontinence (OR=0.94, 95% CI 0.52–1.70,  $p=0.84$ ), and erectile dysfunction (OR=0.85, 95% CI 0.41–1.76,  $p=0.65$ ).

**Conclusion** There was no difference in complications between the two surgical modalities at long-term follow-up, however, PR presents more advantages in reduce operative times, frequency of postoperative infections, cost, and long-term quality of life.

**Clinical trial number** Not applicable.

**Keywords** Pelvic fracture urethral injury, Primary realignment, Delayed urethroplasty, Pediatric

\*Correspondence:

Qinlin Shi

485141@hospital.cqmu.edu.cn

<sup>1</sup>Department of Urology Children's Hospital of Chongqing Medical University, National Clinical Research Center for Child Health and Disorders, Chongqing, China

<sup>2</sup>Ministry of Education Key Laboratory of Child Development and Disorders, Chongqing Key Laboratory of Structural Birth Defect and Reconstruction, Chongqing, China



© The Author(s) 2025. **Open Access** This article is licensed under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License, which permits any non-commercial use, sharing, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if you modified the licensed material. You do not have permission under this licence to share adapted material derived from this article or parts of it. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by-nc-nd/4.0/>.

## Introduction

Among children sustaining pelvic fractures, the incidence of urethral injury related to these fractures (PFUI) ranges from 0.47–4.2% [1]. A multicenter study in China further corroborated this range, reporting an incidence of approximately 2.3% [2]. Patients with PFUI experience a high rate of complications after surgery, including postoperative urinary tract infections, urethral stricture, erectile dysfunction, and urinary incontinence [3]. This makes treating PFUI in children a significant challenge for pediatric urologists. Due to the relatively low incidence of PFUI in children, treatment protocols often rely on principles used for adult urethral injuries, resulting in substantial controversy [4]. A major debate centers on whether to opt for suprapubic cystostomy with delayed urethroplasty (SCDU) or for primary realignment (PR).

SCDU is favored in the early phase because of its simplicity, lower blood loss, and its capacity to manage other associated injuries. Additionally, it avoids retropubic exploration, thereby reducing the risk of erectile dysfunction and urinary incontinence by preventing upward traction of the prostate and bladder [5]. However, this approach has significant drawbacks, including increased risks of catheter-related infections and stone formation, the complexity of delayed repair, and the psychological impact of requiring a second surgery and prolonged use of a drainage bag [6]. Consequently, if clinical conditions permit, many scholars advocate for PR. This method aims to realign the proximal urethra with the distal stump, minimizing the risk of stricture formation or defects. The introduction of endoscopic technology has added a new dimension to this debate, as endoscopic realignment may prevent adverse effects on erectile function and continence by sparing periprostatic tissues and cavernous nerves from additional trauma. Critics of primary realignment argue that it is technically demanding and, if unsuccessful, may complicate subsequent urethroplasty [7]. They contend that complete urethral disruptions do not heal by realignment alone and that successful cases often result from partial disruptions, which might be adequately treated with just suprapubic cystostomy [8].

Given the limited evidence on outcomes in pediatric patients with PFUI, this study aims to compare early PR with SCDU from multiple perspectives, including perioperative parameters, complication rates, patient satisfaction, treatment costs, and quality of life.

## Methods

### Study design

This study was approved by the Institutional Ethics Committee. A retrospective analysis was performed on patients treated for PFUI at the Urology Department of Children's Hospital of Chongqing Medical University between January 2004 and December 2023. We excluded

patients with incomplete urethral ruptures, prior micriturition abnormalities, female patient, or incomplete clinical data, resulting in a cohort of 68 eligible male participants (Fig. 1). Data on demographics, treatment plans, outcomes, and outpatient records were retrospectively collected. Postoperative follow-ups occurred at 3, 6, and 12 months, and annually thereafter.

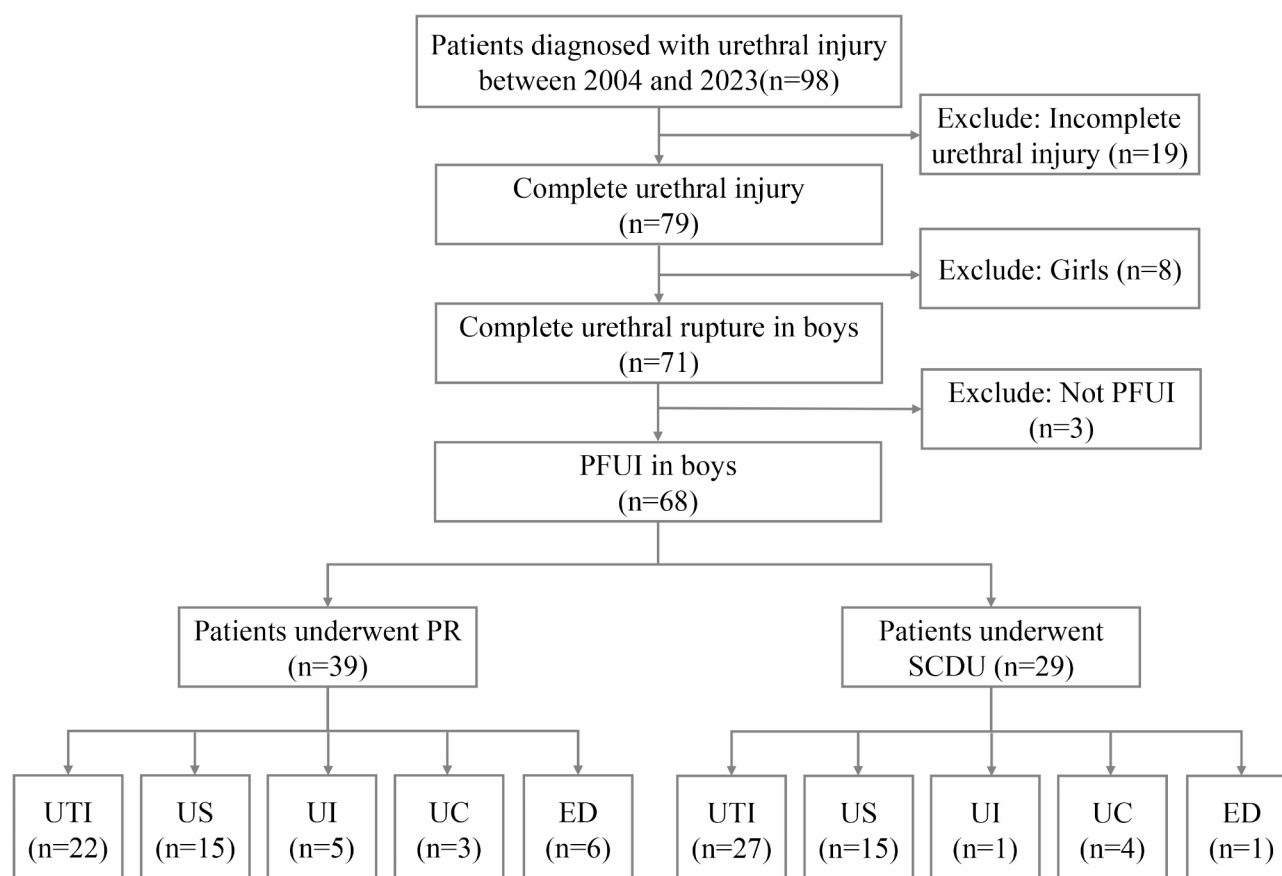
We assessed parental satisfaction and patients' health-related quality of life (HRQoL) through post-operative outpatient visits and telephone interviews. Satisfaction levels were categorized as "satisfied," "neutral," or "dissatisfied." For patients aged 5–15, we used the PedsQL 4.0 Generic Core Scale, while patients aged 16 and above were assessed using the SF-36. The scale was completed by the patients themselves and accompanied by their parents.

The PedsQL 4.0 Generic Core Scale, suitable for children over two, assesses HRQoL across physical, emotional, social, and school dimensions, subdivided into sub-scales. The Chinese version has good reliability and validity [9, 10]. It uses a five-point Likert scale (0-never to 4-almost always), with scores transformed linearly to a 0–100 scale to indicate higher HRQoL.

The SF-36, a 36-item health survey for adolescents aged 16 and above, assesses HRQoL across eight dimensions. The scale includes physical functioning (PF), role limitations due to physical problems (RP), bodily pain (BP), general health (GH), vitality (VT), social functioning (SF), role limitations due to emotional problems (RE), and mental health (MH). This widely validated tool is also adapted for use in China, with dimension scores summed and transformed to a 0–100 scale, where higher scores denote better health [11].

According to the guidelines of the American Academy of Pediatrics (AAP), a positive urine culture accompanied by urinary system symptoms is diagnosed as a urinary tract infection (UTI) [12]. Urinary incontinence is defined as the involuntary discharge of urine from the urethral opening, a condition of urinary control dysfunction. Patients were monitored for urethral stricture through voiding history, flow rate measurements, and determination of post-void residual urine volume. The diagnosis was ultimately confirmed by retrograde urethrography (RUG) or cystourethroscopy [13]. Treatment was deemed successful if no obstructive symptoms persisted and no further interventions, such as urethral dilation, internal urethrotomy, or urethroplasty, were required [5]. We find out about erectile function by asking the patients themselves or their parents.

For meta-analysis methods, see Supplementary methods.



**Fig. 1** Flow charts of 68 patients enrolled in the study. Note: PFUI, pelvic fracture-related urethral injury; PR, primary realignment; SCDU, suprapubic cystostomy with delayed urethroplasty; UTI, urinary tract infection; US, urethral stricture; ED, erectile dysfunction; UI, urinary incontinence; UC, Urinary calculus

### Treatment process

All PFUI patients admitted to the hospital must undergo a comprehensive pre-treatment evaluation including medical history collection, physical examination, and assessment of urination (when possible). Radiographic, ultrasonic, and CT imaging should be performed to assess the upper urinary tract. Emergency conditions such as open fractures, spleen laceration, liver rupture, renal injuries, cranial trauma, or fractures of the vertebral arch must be identified and prioritized for immediate treatment. When we find urinary retention in the initial consultation and suspect a urethral break, we place a silicone urinary catheter about 1 cm into the urethral opening, pinch the urethral opening with our hand, and hit the contrast agent to look through the image to see if the urethra is open. So retrograde urethrograms are done preoperatively. Suprapubic tube placement: A transverse incision was made 3–5 cm above the pubic symphysis, adjusted according to the child's body size. The skin, subcutaneous fat, and rectus abdominis muscle were incised layer by layer. A needle was then punctured to aspirate urine, confirming entry into the bladder cavity. The anterior bladder wall was incised for 1–2 cm, and a silicone

Foley catheter was inserted. Finally, the fistula tube was fixed with sutures layer by layer. Urethral realignment: After a median transverse incision was made in the lower abdomen, the skin, subcutaneous tissue, and anterior sheath of the rectus abdominis muscle were incised to reveal the anterior wall of the bladder and the retro-pubic space. The anterior bladder wall was then opened, and the urine inside was aspirated. A probe was inserted through the external openings of both the bladder and the urethra, aligning the ends of the urethra. After a suitable catheter was placed, a drain was positioned in the suprapubic area. The incision was then closed layer by layer, and the catheter was secured. The choice of Foley catheter model needs to be based on the patient's specific condition such as age, thickness of urethra and injuries etc. In children, the commonly used Foley catheter models include 8Fr, 10Fr and 12Fr. All our operations are done in the operating room.

### Statistical analysis

Statistical analyses were conducted using SPSS version 25 and Review Manager version 5.4 (The Cochrane Collaboration, The Nordic Cochrane Centre, Copenhagen,

**Table 1** Characteristics of patients with PFUI

Characteristics	Total (n = 68)	PR (n = 39)	SCDU (n = 29)	p value
Age (years), median (IQR)	7.3(4.8–10.8)	7(4.9–9.8)	8(4.7–11.0)	0.615
Cause of PFUI, n (%)				0.174
Road traffic accident	52(76.5)	26(66.7)	26(89.7)	
Crush injury	4(5.9)	3(7.7)	1(3.5)	
High fall injury	9(13.2)	7(17.9)	2(6.9)	
Straddle injury	3(4.4)	3(7.7)	0(0.0)	
Hemodynamics, n (%)				0.675
Stable	45(66.2)	25(64.1)	20(69.0)	
Unstable	23(33.8)	14(35.9)	9(31.0)	
Length of hospital stay (days), median (IQR)	23(14.7–34.0)	20(13.0–31.0)	27(18.0–36.0)	0.081
Operative time (minutes), median (IQR)	109(80.0–150.0)	90(72.5–120.0)	150(111.0–190.0)	< 0.001
Blood loss (mL), median (IQR)	35(19.8–79.3)	50(24.0–82.5)	26(16.0–56.0)	0.234
Number of operations, median (IQR)	3(2.0–3.0)	2(1.0–3.0)	3(2.0–4.0)	0.020
Treatment cost (USD), median (IQR)	3041.2(2408.1–4187.0)	2653.0(2247.0–2970.2)	4113.2(3359.3–5086.6)	< 0.001
Parental satisfaction, n (%)	48(70.6)	29(74.3)	19(65.5)	0.693

Denmark). The sociodemographic and clinical characteristics of the study population were described using frequency distributions, means with standard deviations (SD), and medians with interquartile ranges (IQR). For quantitative variables, group comparisons were made using the Student's t-test and the Mann-Whitney U test. Qualitative variables were evaluated using either the chi-square test or Fisher's exact test, depending on their appropriateness. The scores of patients with urethral rupture were compared to those of the general Chinese population using a single-sample t-test. To assess the factors contributing to urethral stricture, logistic regression analysis was employed, focusing on both combined effects and independent predictors.

## Results

### Characteristics of patients with PFUI

From 2004 to 2023, our institution treated 68 boys with PFUI, which accounted for 69.4% of all urethral rupture cases. The median age of the patients was 7.3 years (range: 4.8–10.8). The most common cause of injury was car accidents, which occurred in 52 cases (76.5%). At presentation, 23 patients (33.8%) were hemodynamically unstable.

A total of 39 patients underwent PR, while 29 received SCDU. A comparative analysis revealed no significant differences between the two groups in terms of age, cause of PFUI, intraoperative blood loss, hemodynamics upon admission, or parental satisfaction (all  $p > 0.05$ , as shown in Table 1). However, PR was associated with a significantly shorter median operative time of 90 min (range:

**Table 2** Comparison outcomes of different operations in patients with PFUI

Characteristics	Total (n = 68)	PR (n = 39)	SCDU (n = 29)	p value
Postoperative urinary tract infection, n (%)	49(72.1)	22(56.4)	27(93.1)	< 0.001
Urethral stricture, n (%)	30(44.1)	15(38.5)	15(51.7)	0.276
Urinary incontinence, n (%)	6(8.8)	5(12.8)	1(3.45)	0.360
Urinary calculus, n (%)	7(10.3)	3(7.7)	4(13.8)	0.678
Erectile dysfunction, n (%)	7(10.3)	6(15.4)	1(3.5)	0.231

72.5–120.0), compared to the SCDU group ( $p < 0.001$ ). Additionally, the PR group experienced lower treatment costs, with an average of 2653 USD (range: 2247.0–2970.2), and required fewer procedures, with a median of 1 (range: 1–3) (all  $p < 0.05$ ). The median follow-up period of 2 years (range 1–15 years).

### Management of complications

In 68 patients with PFUI who received treatment, 49 (72.1%) developed a urinary tract infection postoperatively. The incidence was significantly higher in the SCDU group, with 27 cases (93.1%), compared to 22 cases (56.4%) in the PR group ( $p < 0.001$ ), as shown in Table 2. Our study demonstrated that Gram-negative bacteria were more prevalent, accounting for 68.8% of the 77 isolated strains. The remaining 31.2% were Gram-positive bacteria. Among the Gram-negative pathogens, *Escherichia coli* and *Pseudomonas aeruginosa* were most common, each accounting for 9 strains (11.7%). In the Gram-positive cohort, *Enterococcus faecalis* was the predominant pathogen, with 12 strains (15.6%) isolated.

Additionally, four patients' culture results revealed fungal infections. The detailed distribution of these pathogens is shown in Supplementary Fig. 2 and Supplementary Table 1.

Among the 30 patients with urethral stricture, there was no significant difference in incidence between the PR group (15 cases, 38.5%) and the SCDU group (15 cases, 51.7%) ( $p=0.28$ ). Notably, 90% of these cases occurred within one year following injury. Thirteen patients underwent urethral dilatation, with a success rate of 53.8% (66.7% in the PR group and 42.9% in the SCDU group). Three patients underwent internal urethrotomy, with a success rate of 13.3% (100% in the PR group and 0% in the SCDU group). Fourteen patients underwent resection of the urethral stricture with end-to-end anastomosis, achieving a success rate of 50% (25% in the PR group and 83.3% in the SCDU group), as shown in Table 3. The specific treatment details for the 30 urethral stricture patients are provided in Supplementary Table 2.

Multivariate logistic regression analysis revealed that hemodynamic instability (OR 5.02, 95% CI 1.46 to 17.26;  $p=0.010$ ) were independent risk factors for developing urethral stricture, as shown in Supplementary Table 3. Furthermore, there were no significant differences between the PR and SCDU groups in terms of the incidence of urinary incontinence or urinary calculus (all  $p>0.05$ ).

### HRQoL of patients with PFUI

Questionnaire feedback from 18 patients with PFUI, aged between 5 and 15 years. The results indicate that their scores in all modules, except for Emotional Functioning, were significantly lower than the norms established for the general Chinese population based on a comprehensive survey ( $p<0.05$ ) [14]. Similarly, data from 28 patients aged over 16 years show that scores in the modules of PE, RP, BP, GH, SE, RE, and MH were also substantially below the standard norms derived from multiple provinces in China ( $p<0.05$ ) [15] (see supplementary Table 4). Subsequently, the patients were divided into two groups: PR and SCDU, for comparative analysis. Among patients aged 5–15 years, the PR group exhibited significantly higher scores in Physical Health, Psychological Health, and the Total Scale compared to the SCDU group. Furthermore, among patients over 16 years of age, the PR

group scored significantly higher in BP, GH, and MH compared with the SCDU group (see supplementary Table 5).

### Meta-analysis of surgical approaches in PFUI in children

All investigations were retrospective, non-randomized comparative studies. Supplementary Fig. 2 illustrates the PRISMA flow diagram, detailing the studies incorporated in the present analysis. Quality assessment of the included studies using the Newcastle-Ottawa Scale (NOS) revealed that all studies were rated as moderate or good quality. The quality assessment details for each study are summarized in Supplementary Table 2.

Heterogeneity analysis showed that the exclusion of any individual study did not significantly affect the overall statistical significance, thereby affirming the robustness of the meta-analysis results. Moreover, the funnel plot exhibited symmetrical distribution, suggesting no evidence of publication bias in this study. The corresponding funnel plots are displayed in Supplementary Figs. 3, 4, and 5.

The meta-analysis encompassed eight studies with a total of 432 patients. The characteristics of PFUI patients included in the analysis are outlined in Table 4 [6, 16–21]. The results revealed no significant differences in the incidence of urethral stricture (OR 0.60, 95% CI 0.33–1.10,  $p=0.10$ ; Fig. 2A), urinary incontinence (OR 0.94, 95% CI 0.52–1.70,  $p=0.84$ ; Fig. 2B), or erectile dysfunction (OR 0.85, 95% CI 0.41–1.76,  $p=0.65$ ; Fig. 2C) among treated children with PFUI.

### Discussion

The prevalence of PFUI in children is low, and there are relatively few studies on it, leading to treatments and management strategies that are often modeled after those used for adults [22]. However, urethral injuries in children are more complex than in adults. In children, prostatic dysplasia, intra-abdominal bladder, and smaller urethral caliber can result in injuries that extend proximally to the bladder neck and distally to the bulbous urethra. Additionally, the pelvis in children is less brittle and more elastic, and the periosteum is thicker. The increased elasticity of the pubic symphysis and sacroiliac joints means that PFUI in children typically requires greater amounts of energy [23]. As a result, patients with PFUI

**Table 3** Management and success rate of urethral stricture after different treatment modalities

	Total (n = 30)		PR (n = 15)		SCDU (n = 15)	
	Patients	Success	Patients	Success	Patients	Success
Urethral dilatation	13	7(53.8%)	6	4(66.7%)	7	3(42.9%)
Internal urethrotomy	3	1(33.3%)	1	1(100.0%)	2	0(0%)
End-to-end anastomosis*	14	7(50.0%)	8	2(25.0%)	6	5(83.3%)

**Note:** \* This refers to excision of urethral stricture and end to end urethral anastomosis

**Table 4** Characteristics of the studies about children PFUI

Researcher	Year	Country	Follow-up (months)	Sample Size	Outcomes: PR vs. SCDU	Recommended operation
Avanoglu	1996	Turkey	6-144	18	US:7/14(50%) vs. 2/4(50%) UI:4/14(28.6%) vs. 2/4(50%)	PR
Qu	2014	China	3-12	177	US:2/35(5.7%) vs. 17/142(12%) NP:1.1 vs. 2.6 ED:3/35(8.6%) vs. 31/142(21.8%) UI:4/35(11.4%) vs. 25/142(17.6%)	PR
Nerli	2008	India	25-132	22	US:5/12(41.7%) vs. 5/10(50%) UC:0/12(0%) vs. 1/10(10%) UI:0/12(0%) vs. 0/10(0%)	PR
Taha	2023	Egypt	NA	40	NP:3.5 vs. 2 UI:4/20(20%) vs. 6/20(30%)	SCDU
Balkan	2005	Turkey	4-5	20	US:2/12(16.6%) vs. 3/8(37.5%) UI:1/12(8.3%) vs. 1/8(12.5%)	PR
Podesta	2015	Argentina	78	49	ED:1/14(7.1%) vs. 2/35(5.7%) UI:4/14(28.6%) vs. 5/35(14.3%)	PR
Onen	2005	Turkey	48-204	38	US:5/22(22.7%) vs. 4/16(25%) ED:5/22(22.7%) vs. 3/16(18.8%) UI:4/22(18.2%) vs. 3/16(18.8%)	PR

Note: PR, primary realignment; SCDU, suprapubic cystostomy with delayed urethroplasty; US, urethral stricture; ED, erectile dysfunction; UI, urinary incontinence; NP, Number of procedures; UC, Urinary calculus

may also experience multiple simultaneous injuries, including bladder rupture, rectal rupture, and damage to the spleen, liver, or kidneys, as well as fractures, craniocerebral injuries, and pneumothorax. In our study, 23 patients (33.8%) presented with hemodynamic instability due to organ injuries. For these patients, life-threatening organ injuries should be prioritized, and management of urethral injuries should only begin once vital signs have stabilized.

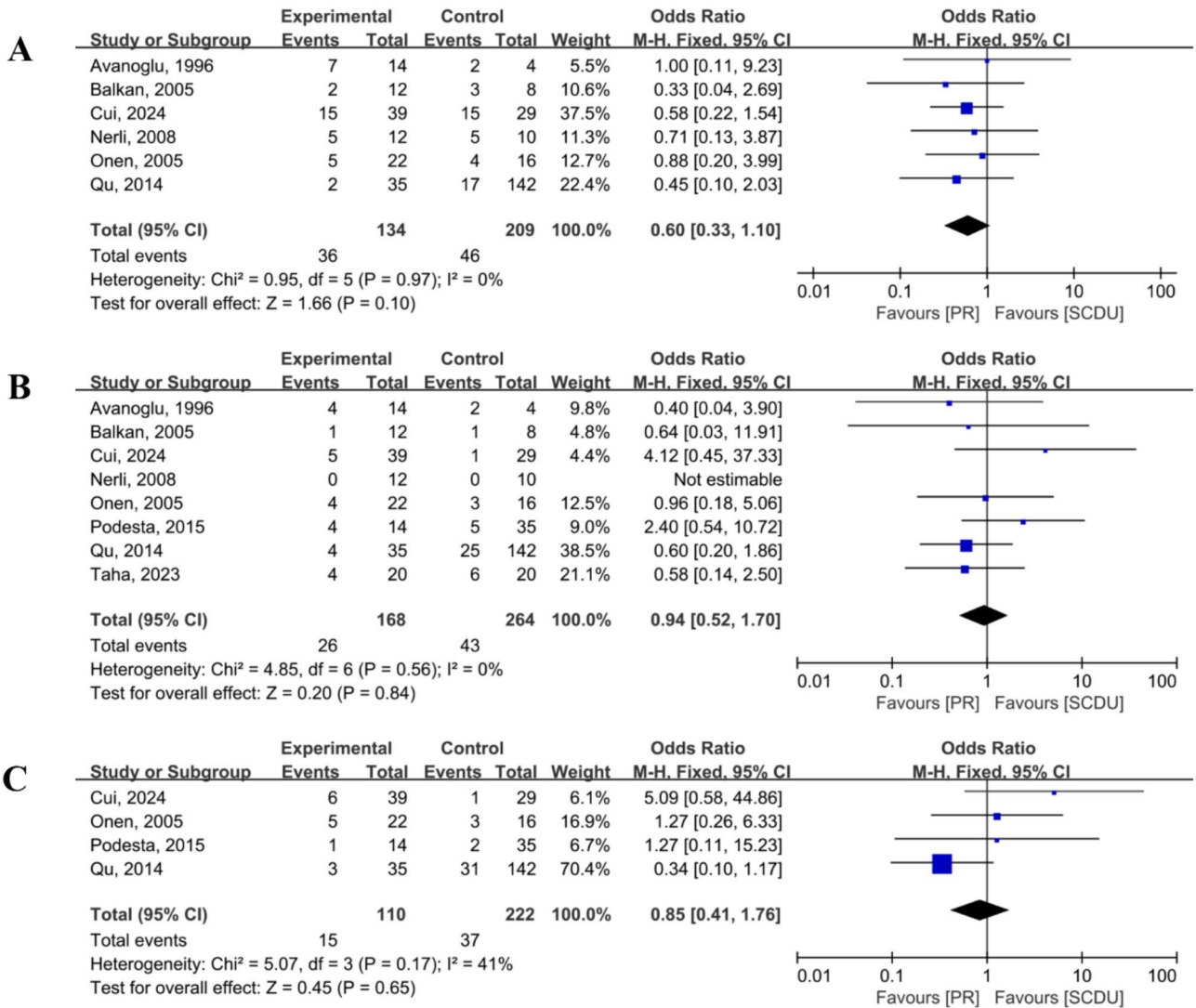
The initial treatment of PFUI is controversial, with two main approaches: PR versus SCDU. PR prevents the extravasation of urine into surrounding tissues at an early stage, reduces inflammation, and facilitates the complete reapproximation of the separated urethral mucosal margins, promoting urethral regeneration. On the other hand, SCDU allows for the management of more complex and urgent injuries in other areas, without manipulating the urethra and prostate, thus reducing the risk of impotence and incontinence. Our results showed a high incidence of postoperative urinary tract infections, with 72.1% of patients with PFUI and 93.1% of patients in the SCDU group developing infections. This is significantly higher than the 56.4% in the PR group. The most common pathogens were *Enterococcus faecalis*, *Staphylococcus aureus*, *Escherichia coli*, and *Pseudomonas aeruginosa*, in that order. This is similar to the results of previous studies [24]. It is important to note that in cases where antibiotics are ineffective, the possibility of fungal infections should be considered. In our study, 4.6% of infections were fungal, which may be linked to prolonged antibiotic use, indwelling urinary catheters, and reduced resistance after injury. There was no significant difference in the incidence of urethral stricture, urinary stones,

urinary incontinence, or erectile dysfunction between the two groups, consistent with the findings of Wilbert et al. in their systematic review of initial PFUI treatment in children [25].

We reviewed seven papers on urethral injuries in children, with seven supporting the use of PR and one opposing it. The opponents argued that PR neither prevents urethral strictures nor simplifies subsequent urethroplasty, exposing patients to a higher number of surgeries. In their study, PR required an average of 3.5 procedures, while SCDU required only 2. However, our study, along with that of Qu et al., showed that patients who underwent PR required 2 and 1.1 fewer procedures, respectively, compared to those who underwent SCDU. Our meta-analysis showed no difference between PR and SCDU in the incidence of urethral stenosis. A systematic review of adults with PFUI concluded that early PR reduces the incidence of urethral strictures [26]. While there is ongoing debate about whether PR treatment can prevent strictures, it is clear that PR has not been shown to increase the risk of urethral strictures in any study. Moreover, multifactorial analysis identified hemodynamic instability at the time of presentation as an independent risk factor for subsequent urethral stricture, indicating that more severe trauma, often accompanied by significant scarring, leads to a higher likelihood of strictures.

The impact of PFUI on the quality of life and psychological well-being of children is substantial. Comparisons of PedsQL and SF-36 scores between patients with urethral rupture and the general population revealed that the HRQoL for these patients was lower, due to physical discomfort from trauma, repeated medical visits,





**Fig. 2** Forest plot for comparison of **A**) stricture rate **B**) urinary incontinence rate **C**) erectile dysfunction following primary realignment and delayed urethroplasty in patient with pelvic fracture urethral injury

and complex complications. Patients who received PR demonstrated better HRQoL than those who underwent SCDU. This difference may be due to the inconvenience of living with an ostomy tube in the SCDU group, the higher incidence of infections, and the increased number of surgeries required. Onen et al. found that approximately 43% of children with urethral injuries develop psychological disorders post-treatment [27]. In our study, two patients were seen in our psychological clinic. Several parents reported that their children became less willing to socialize and showed significant declines in academic performance following their injuries.

Our study has several limitations. The cohort analyzed is relatively small and derived from a single center. The number of erectile dysfunction cases may have been underreported, as some patients were too young to describe their symptoms and some parents may not have

noticed them. Additionally, the lack of urodynamic studies is a limitation.

In conclusion, there was no difference in complication rates between PR and SCDU, but PR offers several advantages over SCDU as the initial treatment for PFUI, including shorter operative times, lower treatment costs, fewer required surgeries, a lower incidence of postoperative infections, and better long-term quality of life for patients.

- Abbreviations**
- PFUI Pelvic Fracture-related Urethral Injury
  - PR Primary Realignment
  - SCDU Suprapubic Cystostomy with Delayed Urethroplasty
  - HRQoL Health-Related Quality Of Life
  - AAP American Academy of Pediatrics
  - RUG Retrograde urethrography
  - UTI Urinary Tract Infection
  - US Urethral Stricture

ED Erectile Dysfunction  
UC Urinary Calculus  
UI Urinary Incontinence

## Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s12887-025-05611-x>.

Supplementary Material 1

## Author contributions

Kongkong Cui: Conceptualization, Investigation, Writing—original draft. Peng Hong: Data curation, Visualization. Honggang Fang: Visualization. Zaihong Hu: Methodology. Jie Lin: Methodology. Deying Zhang: Project administration. Xing Liu: Project administration. Xiaomao Tian: Software, Formal analysis. Qinlin Shi: Conceptualization, Investigation, Writing—review and editing. Shengde Wu: Conceptualization, Supervision. Guanghui Wei: Conceptualization, Validation.

## Funding

This study was supported by the China Postdoctoral Science Foundation (No. 2022M720609) and the National Natural Science Foundation of China (No. 82302948).

## Data availability

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

## Declarations

### Ethical approval

This study was approved by the Institutional Research Ethics Board of Children's Hospital affiliated Chongqing Medical University (Date: 2025/No: 057). All procedures in the study were carried out in accordance with national ethical guidelines for medical and health research involving human subjects, as well as the 1964 Helsinki Declaration and its subsequent amendments. Each child had an informed consent form signed by their legal guardian(s).

### Consent for publication

Not applicable.

### Competing interests

The authors declare no competing interests.

Received: 2 February 2025 / Accepted: 19 March 2025

Published online: 04 April 2025

## References

- Voelzke BB, Breyer BN, McAninch JW. Blunt pediatric anterior and posterior urethral trauma: 32-year experience and outcomes. *J Pediatr Urol*. 2012;8(3):258–63.
- Qiu X, Zhu T, Deng H, Chen J, Feng H, Huang Z, et al. Multicenter epidemiological analysis of related factors in 10,808 hospitalized children with lower limb and pelvic fractures in China. *Sci Rep*. 2024;14(1):27860.
- Elshout PJ, Veskima E, MacLennan S, Yuan Y, Lumen N, Gonsalves M, et al. Outcomes of early endoscopic realignment versus suprapubic cystostomy and delayed urethroplasty for pelvic Fracture-related posterior urethral injuries: A systematic review. *Eur Urol Focus*. 2017;3(6):545–53.
- Trachta J, Moravek J, Kriz J, Padr R, Skaba R. Pediatric bulbar and posterior urethral injuries: operative outcomes and Long-Term Follow-Up. *Eur J Pediatr Surg*: Official J Austrian Association Pediatr Surg [et al] = Z fur Kinderchirurgie. 2016;26(1):86–90.
- Zou Q, Zhou S, Zhang K, Yang R, Fu Q. The immediate management of pelvic fracture urethral Injury-Endoscopic realignment or cystostomy?? *J Urol*. 2017;198(4):869–74.
- Qu Y, Zhang W, Sun N, Huang C, Tian J, Li M, et al. Immediate or delayed repair of pelvic fracture urethral disruption defects in young boys: Twenty years of comparative experience. *Chin Med J (Engl)*. 2014;127(19):3418–22.
- Tausch TJ, Morey AF. The case against primary endoscopic realignment of pelvic fracture urethral injuries. *Arab J Urol*. 2015;13(1):13–6.
- Moudouni SM, Patard JJ, Manunta A, Guiraud P, Lobel B, Guille F. Early endoscopic realignment of post-traumatic posterior urethral disruption. *Urology*. 2001;57(4):628–32.
- Yang X, Xiao N, Yan J. The PedsQL in pediatric cerebral palsy: reliability and validity of the Chinese version pediatric quality of life inventory 4.0 generic core scales and 3.0 cerebral palsy module. *Qual Life Res*. 2011;20(2):243–52.
- Varni JW, Seid M, Kurtin PS. PedsQL 4.0: reliability and validity of the pediatric quality of life inventory version 4.0 generic core scales in healthy and patient populations. *Med Care*. 2001;39(8):800–12.
- Liu D, Zhang YF. Analysis of factors affecting the clinical efficacy and quality of life in the treatment of pediatric acute lymphoblastic leukemia. *Pak J Med Sci*. 2024;40(5):956–61.
- Brandstrom P, Hansson S. Urinary tract infection in children. *Pediatr Clin North Am*. 2022;69(6):1099–114.
- Chaker K, Bibi M, Ouanes Y, Chedly WB, Rahoui M, Dali KM, et al. Comparison of long-term results according to the primary mode of management of injury for posterior urethral injuries. *Int Urol Nephrol*. 2023;55(8):1971–5.
- Hao Y, Tian Q, Lu Y, Chai Y, Rao S. Psychometric properties of the Chinese version of the pediatric quality of life inventory 4.0 generic core scales. *Qual Life Res*. 2010;19(8):1229–33.
- Rui W, Cheng W, Ma XQ, Zhao YF, Yan XY, Jia H. Health-related quality of life in Chinese people: a population-based survey of five cities in China. *Scand J Public Health*. 2011;39(4):410–8.
- Taha TM, Ali MO, Shahat AA, Abdalla MA, Hammouda HM, Behnsawy HM. Does primary urethral realignment improve the outcome of pediatric pelvic fracture urethral injury? A randomized controlled trial. *Int J Urol*. 2023;30(10):922–8.
- Podesta M, Podesta M. Jr. Delayed surgical repair of posttraumatic posterior urethral distraction defects in children and adolescents: long-term results. *J Pediatr Urol*. 2015;11(2):e671–6.
- Onen A, Ozturk H, Kaya M, Otcu S. Long-term outcome of posterior urethral rupture in boys: a comparison of different surgical modalities. *Urology*. 2005;65(6):1202–7.
- Nerli RB, Koura AC, Ravish IR, Amarkhed SS, Prabha V, Alur SB. Posterior urethral injury in male children: long-term follow up. *J Pediatr Urol*. 2008;4(2):154–9.
- Balkan E, Kilic N, Dogruyol H. The effectiveness of early primary realignment in children with posterior urethral injury. *Int J Urol*. 2005;12(1):62–6.
- Avanoglu A, Ulman I, Herek O, Ozok G, Gokdemir A. Posterior urethral injuries in children. *Br J Urol*. 1996;77(4):597–600.
- Demetriades D, Karaiskakis M, Velmahos GC, Alo K, Murray J, Chan L. Pelvic fractures in pediatric and adult trauma patients: are they different injuries? *J Trauma*. 2003;54(6):1146–51. discussion 51.
- Kulkarni SB, Barbagli G, Kulkarni JS, Romano G, Lazzeri M. Posterior urethral stricture after pelvic fracture urethral distraction defects in developing and developed countries, and choice of surgical technique. *J Urol*. 2010;183(3):1049–54.
- Chowdhury SS, Tahsin P, Xu Y, Mosaddek ASM, Muhamadali H, Goodacre R. Trends in antimicrobial resistance of uropathogens isolated from urinary tract infections in a tertiary care hospital in Dhaka, Bangladesh. *Antibiot (Basel)*. 2024;13(10).
- Joe W, Owen K, Ivander A, Jaya AP, Palgunadi IN, Adhyatma KP, et al. A systematic review and meta-analysis of surgical approaches in pelvic fracture-associated urethral injury in children: primary endoscopic realignment versus delayed urethroplasty. *Injury*. 2024;55(10):111728.
- Barrett K, Braga LH, Farrokhhyar F, Davies TO. Primary realignment vs suprapubic cystostomy for the management of pelvic fracture-associated urethral injuries: a systematic review and meta-analysis. *Urology*. 2014;83(4):924–9.
- Onen A, Subasi M, Arslan H, Ozen S, Basuguy E. Long-term urologic, orthopedic, and psychological outcome of posterior urethral rupture in children. *Urology*. 2005;66(1):174–9.

## Publisher's note

Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.